GANITANUYOGA

The Mathematics of the Jain Tradition

A Complete History, from Canon to Classical Masters

PART ONE: FOUNDATIONS

Draft Manuscript — Chapters 1–3 of an ongoing four-part work

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Preface

This book exists because a question kept resurfacing during work on a separate project examining how Indian textbooks describe the mathematics of the ancient and classical periods. Authors who discussed the achievements of Aryabhata, Brahmagupta and Bhaskara routinely stopped short of a fourth thread running through the same centuries: the sustained, doctrinally motivated mathematical work of the Jain tradition. That silence is not mysterious once traced to its source. Jain mathematics survives chiefly in Prakrit canonical texts composed for monks rather than merchants, astronomers or court mathematicians; its technical vocabulary is unfamiliar even to many specialists in Sanskrit-language Indian mathematics; and its fullest scholarly synthesis, L. C. Jain's two-volume Exact Sciences from Jaina Sources, was published by a small Jaipur research trust in the early 1980s and never entered wide circulation.[1] The result is a body of work that historians of mathematics have known about for well over a century[2] but that has almost no presence in general accounts of the history of Indian, or world, mathematics.

This book tries to close that gap for an educated general reader, not only a specialist one. It proceeds chronologically, from the mathematics embedded in the earliest Jain scripture through the classical Jain mathematicians of the medieval period, and closes by asking what this material means for how the history of Indian mathematics is currently told. It draws on the canonical texts as rendered in available translation and secondary scholarship, on L. C. Jain's monographs, on the MacTutor History of Mathematics Archive's dedicated treatment of Jaina mathematics,[3] on B. Datta and A. N. Singh's classic History of Hindu Mathematics,[4] and on more recent academic reassessments of early Indian mathematics.

A note on scope and honesty. This is a large undertaking, and it is being built in stages. What follows is Part One, "Foundations": it covers why mathematics mattered to Jain monastic scholars in the first place, and what the canonical sources actually are and how reliably they can be dated. Part Two

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[1]L. C. Jain, Exact Sciences from Jaina Sources, Vol. 1: Basic Mathematics, Rajasthan Prakrit Bharati Sansthan / Sitaram Bhartia Institute of Scientific Research, Jaipur & New Delhi, 1982; Vol. 2: Astronomy and Cosmology, 1983. Both volumes were reviewed in mainstream mathematics journals (see Mathematical Gazette, Mathematical Association, 1968 review of Jain's related work "On the Jaina School of Mathematics") but were never issued by a trade or academic press with wide distribution.

[2]The mathematical content of Jain canonical literature was first drawn to Western scholarly attention in the late nineteenth and early twentieth centuries, notably by German Indologist Georg Bühler and by B. Datta, whose 1929 papers on Jaina mathematics preceded his co-authored History of Hindu Mathematics.

[3]Ian G. Pearce, "Jaina Mathematics," in Indian Mathematics: Redressing the Balance, MacTutor History of Mathematics Archive, University of St Andrews, 2002, https://mathshistory.st-andrews.ac.uk/HistTopics/Jaina_mathematics/

[4]B. Datta and A. N. Singh, History of Hindu Mathematics: A Source Book, Bharatiya Kala Prakashan, Delhi, 2004 reprint (originally published in two parts, 1935 and 1938).

will cover the mathematics of the Agama period itself — the theory of infinity, the early theory of sets, the combinatorics, the geometry. Part Three will cover the classical Jain mathematicians by name, from Umasvati through Mahaviracharya and beyond. Part Four will ask what this tradition's afterlife has been, including the uncomfortable question of why it dropped out of the popular story of Indian mathematics. Each part is being researched and drafted with the same standard of sourcing as this one.

PART ONE — FOUNDATIONS

Chapter One — A Missing Thread in a Celebrated Story

The Familiar Story, and What It Leaves Out

The history of Indian mathematics is, by now, a reasonably well-told story. Most educated readers who have encountered it at all know some version of the following: that Indian mathematicians developed the decimal place-value system and the numeral zero as a full arithmetic object rather than a placeholder; that Aryabhata, writing around 499 CE, gave an approximation for pi and a table of sine values; that Brahmagupta, in the seventh century, worked out rules for arithmetic with zero and negative numbers and made advances in indeterminate equations; that Bhaskara II, in the twelfth century, wrote the Lilavati and Bijaganita and anticipated ideas later associated with calculus. This is a genuine and celebrated achievement, and it is right that it is celebrated.

What is less often mentioned is that running alongside this tradition, for well over a thousand years, was a separate current of mathematical work produced within the Jain monastic and lay scholarly community — a current that was not simply derivative of the Hindu astronomical tradition, but had its own textual lineage, its own vocabulary, its own characteristic problems, and, in the case of its treatment of infinity and of sets, its own genuinely distinctive conceptual contributions. This current runs from canonical scripture composed in the last centuries before the common era through to a named line of medieval mathematician-monks, culminating in the ninth-century Ganita-sara-sangraha of Mahaviracharya — by general scholarly agreement the first text in the Indian tradition devoted purely to mathematics, with no admixture of astronomy.[5]

This book is an attempt to tell that second story on its own terms, in the same depth and with the same narrative attention normally reserved for the Aryabhata-to-Bhaskara line.

What “Erasure” Does and Doesn't Mean Here

The word erasure is a strong one, and it is worth being precise about what claim this book is and is not making, because the honest answer is more interesting than a simple story of suppression.

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[5] J J O'Connor and E F Robertson, "Mahavira," MacTutor History of Mathematics Archive, University of St Andrews, https://mathshistory.st-andrews.ac.uk/Biographies/Mahavira/

Part of the explanation for Jain mathematics' low visibility is simply the ordinary friction of scholarship. The core texts are in Ardhamagadhi Prakrit, a language with a much smaller community of trained readers than Sanskrit. The most important modern synthesis of the material, L. C. Jain's Exact Sciences from Jaina Sources, was produced by a scholar working largely outside the mainstream university history-of-mathematics establishment, published by a Jaipur trust rather than an academic press, and consequently never reviewed, assigned or cited at the rate that a Princeton or Oxford University Press monograph would have been.[6] Even sympathetic historians working on Indian mathematics broadly have sometimes noted that a great deal of the relevant canonical literature has simply not been studied with translation and mathematical commentary side by side.[7]

But friction of access is not the whole explanation, and this book will not pretend that it is. Part Four takes up, with more evidence than can be marshalled in an introduction, a second and more uncomfortable pattern: that in a good deal of popular and even textbook writing on the history of Indian science, mathematicians and astronomers affiliated with the Vedic-Puranic mainstream are named, celebrated and in some cases credited with priority claims over Greek or European figures, while Jain contributors working in the same centuries, on genuinely comparable problems, are simply absent — not disputed, not critiqued, just absent. That is a different phenomenon from language-access friction, and it deserves to be examined as such rather than folded into a single vague complaint. This book tries to keep those two explanations — scholarly neglect from source difficulty, and curricular omission along community lines — analytically separate throughout, rather than treating the second as a foregone conclusion. Readers should expect Part Four to argue a case with evidence, not simply assert one in advance.

The Shape of the Evidence

It is worth being clear at the outset about what kind of mathematics this book is describing, because it is not exactly what a modern reader expects when hearing the word. Almost none of the Jain mathematical material was produced for its own sake, in the way a modern research paper is. It arose out of a specific doctrinal need: Jain cosmology describes a finite physical universe of enormous but bounded size, populated by beings in a vast but ultimately structured hierarchy of states determined by karma, existing across time-cycles of staggering length. Describing that cosmology with any precision required numbers — not approximate, rhetorical numbers, but numbers manipulated with actual arithmetic rigor, including, remarkably, numbers understood to be genuinely without upper bound. Out of the demand to quantify a religious cosmology, in other words, Jain scholars built tools — a theory of very large numbers, a working distinction between different orders of infinity, an early theory of sets constructed through repeated operations, and a well-developed combinatorics used to

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[7] D. P. Agrawal, "Ancient Jaina Mathematics: An Introduction," Infinity Foundation, infinityfoundation.com; see also the parallel treatment in Indic Mandala and Jainology archives, which draw on the same primary scholarship.

count possible arrangements of philosophical categories — that have a level of formal sophistication historians of mathematics have found genuinely startling when set beside anything else in the ancient world.[8]

This is why the story cannot simply be inserted as a paragraph into a chapter about someone else's mathematics. It has to be told from its own starting point, which is theology and cosmology, not arithmetic for its own sake — and Chapter Two of this book takes up exactly that starting point.

How This Book Is Organized

The book is arranged in four parts. Part One, which this chapter opens, lays the groundwork: it explains why mathematics was a formal branch of Jain religious literature at all (Chapter Two), and it surveys the canonical texts themselves — what they are, how they have been dated, and how reliable those dates are (Chapter Three). Part Two moves into the substance of the earliest, canonical-period mathematics: the theory of number and the ten topics of the discipline the tradition called Sankhyana, the theory of multiple infinities, the early theory of sets, the proto-logarithmic laws of indices, the combinatorics of the Bhagavati Sutra, the geometry and value of pi used in cosmological calculation, and the tradition's characteristic fascination with enormous cosmological quantities. Part Three turns to named individuals: the philosopher-mathematicians Umasvati, Virasena and Nemicandra, and then the purely mathematical work of Mahaviracharya and the smaller figures — Thakkura Pheru, Sridhara, Simhatilakasuri — who followed him, along with the tradition's transmission into regional languages. (A useful distinction runs through this part of the story: some of these figures, such as Sridhara and Mahaviracharya, were mathematicians by primary vocation, while others, such as Virasena and Nemicandra, were monastic philosophers for whom mathematics was a secondary but serious pursuit.[9]) Part Four steps back to ask what all of this adds up to: a genuine comparison with later Western mathematics, especially Cantor's set theory; an honest look at how this material relates to "Vedic mathematics" claims that circulate in contemporary Indian public discourse; and a case study of how the omission actually happens in curricular materials.

A Word on Method

Two methodological commitments run through the whole book and are worth stating plainly here rather than leaving implicit.

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[8]Pearce, "Jaina Mathematics": "By the second century AD the Jaina had produced a theory of sets. In Satkhandagama various sets are operated upon by logarithmic functions to base two, by squaring and extracting square roots, and by raising to finite or infinite powers."

[9]Encyclopedia of Jainism, "Contribution of Ancient Jaina Scholars to Modern Mathematics," encyclopediaofjainism.com. The author notes that of the historically significant Jain contributors to mathematics, Sridhara, Mahavira, Simhatilakasuri and Thakkura Pheru were mathematicians by primary vocation, while Yativrsabha, Virasena, Nemicandra and Todarmala were monastic philosophers whose doctrinal writing carried mathematical content as a secondary feature.

The first concerns dating. Early Indian texts of every tradition — Vedic, Buddhist, Jain — present serious chronological problems: they were transmitted orally for long periods before being fixed in writing, and the surviving manuscripts are typically many centuries younger than the content they preserve. This book follows the convention used by the sources it draws on most heavily, giving the range or the traditionally assigned date for a text's core content while flagging, wherever the secondary literature does, that this is not the same claim as dating the physical manuscript.[10] Readers should treat every date before roughly the ninth century CE, when we reach an author (Mahaviracharya) whose work and patron can be independently cross-checked against dated inscriptions, as an approximate scholarly consensus rather than a certainty — a caution echoed in recent academic reassessments of how early Indian mathematics as a whole is dated and periodized.[11]

The second concerns comparison. It is tempting, and this book will sometimes give in to the temptation, to describe Jain ideas about infinity or sets in terms borrowed from later Western mathematics — to say that a given classification "anticipates" Cantor, for instance. That language is used carefully in this book, and always with the underlying claim stated precisely: the claim is about conceptual resemblance in classification, not about influence, priority in a modern technical sense, or equivalence of formal apparatus. Jain scholars did not have set-builder notation or a formal axiomatic method; they had a doctrinal need to classify quantities with precision, and they built remarkably sophisticated tools to do it. Both things are true at once, and the chapters that follow try to hold onto both.

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[10]Surya Prajnapti and Jambudvipa Prajnapti are conventionally dated to around the fourth century BCE by historians working from internal and comparative evidence, though, as with most early Indian texts, the surviving redactions are considerably later than the traditional dates assigned to their content; see Pearce, "Jaina Mathematics," and Agrawal, "Ancient Jaina Mathematics."

[11]"Emergence of Mathematics in Ancient India: A Reassessment," arXiv:2403.04823, 2024.

Chapter Two — Ganitanuyoga: Mathematics as a Branch of Jain Doctrine

The Four-Fold Division of Jain Scripture

To understand why a religious tradition produced sustained, technically serious mathematics over more than a millennium, it helps to start with how that tradition organized its own literature. Jain scholastic tradition divides its vast canonical and commentarial output into four broad streams, called anuyoga — a Prakrit and Sanskrit term meaning roughly "exposition" or "line of exposition."[12] The four streams are prathamanuyoga, devoted to narrative and legendary literature — the lives of the Tirthankaras, didactic stories, moral exempla; charananuyoga, devoted to conduct, monastic discipline and ethics; dravyanuyoga, devoted to metaphysics, the theory of substance (dravya) and the categories of reality; and karananuyoga — more commonly referred to in the secondary literature by its alternative name, ganitanuyoga, literally "the exposition through calculation" — devoted to mathematics, astronomy and cosmology together, treated as a single, continuous field of knowledge.

This is worth pausing on, because the grouping itself is a claim about what mathematics is for. In the fourfold Jain scheme, mathematics is not classified alongside logic or epistemology (which sit within dravyanuyoga, as part of the general theory of knowledge and reality); it is classified alongside astronomy and cosmology, as a technique for describing the physical and temporal structure of the universe. A Jain monk trained in ganitanuyoga was not, in the first instance, being trained as what a modern reader would call a mathematician. He was being trained to give a precise quantitative account of the Jain cosmos — its shape, its size, the layout of its continents and oceans, the length of its cosmic time-cycles, the number and classification of the beings within it, and the workings of the karmic mechanism that moved souls between states. Mathematics was the instrument for that account, and it was cultivated with real rigor precisely because the account it served was considered doctrinally essential, not because number was interesting in the abstract.

Why Cosmology Demanded Precision

It is easy to underestimate how much quantitative specificity Jain cosmology actually requires, and that specificity is the direct engine of the mathematics this book covers. Jain cosmological texts do not describe the universe in vague or purely symbolic terms. They give the Jambudvipa, the central continent of the Jain cosmos, a specific diameter, and derive from that diameter a specific circumference and area, using an explicit value for the ratio between them — the early Jain

[12]Exact Sciences from Jaina Sources, Vol. 2, Foreword: the four-fold traditional division of Jain canonical literature is given as prathamanuyoga (narrative/legendary literature), karananuyoga -- also rendered ganitanuyoga -- (mathematics, astronomy and cosmology), charananuyoga (conduct and ethics) and dravyanuyoga (metaphysics of substance). Terminology and exact groupings vary somewhat between Digambara and Svetambara commentarial traditions.

approximation of pi as the square root of ten, roughly 3.1623, appears repeatedly across canonical astronomical texts for exactly this purpose.[13] They describe the layered structure of hell-realms and heavenly abodes with specific numbers of layers and specific proportions. They describe the length of cosmic time-cycles using named units that increase in magnitude far beyond any practical counting need — units built by repeated multiplication and exponentiation, precisely because the doctrinal claims being made (about the near-eternity of the cycle of transmigration, for instance) required numbers that could represent durations for which no everyday numeral would suffice.

This is also the doctrinal root of the tradition's famous preoccupation with different kinds, and different sizes, of infinity, which Part Two of this book treats in full technical detail. Jain metaphysics holds that certain categories of thing in the universe — space-points, moments of time, the finest particles of matter, and, crucially, souls (jiva) — are literally infinite in number, while other categories are merely very large but ultimately countable in principle ("innumerable", asankhyata, as a formal intermediate category between the finite and the infinite). Making that three-way distinction — finite, innumerable, infinite — usable in actual doctrinal argument, rather than leaving it as a piece of rhetoric, required the tradition to build working definitions and even something resembling operations on these categories: what happens, formally, when an innumerable quantity is combined with another, or raised to a power, or compared to a different innumerable quantity. That demand is what produced the theory of sets that the second-century-CE text Satkhandagama is credited with originating — a genuine, if doctrinally motivated, formal theory, not a metaphor.[14]

The Character This Origin Gave the Mathematics

Because ganitanuyoga grew out of cosmological and karmic description rather than out of trade, administration, or astronomy-for-navigation, it has a recognizably different character from other ancient mathematical traditions, and naming that character clearly is useful before working through the technical material in later chapters.

Compared with Old Babylonian mathematics, which grew largely out of administrative record-keeping and produced sophisticated but essentially practical arithmetic and algebra, Jain mathematics is much less interested in solving concrete problems of measurement or exchange and much more interested in exhaustive classification — in enumerating every possible case of something (every possible arrangement, every possible category of soul, every possible type of infinity) rather than in solving a single applied problem. Compared with classical Greek mathematics, which built an axiomatic-deductive structure around geometric proof, Jain mathematics has comparatively little interest in proof as a genre — canonical texts state results and worked methods, in the terse aphoristic sutra style, without the discursive justificatory apparatus of a Euclidean proof — but a much deeper and earlier interest in combinatorics, in indices and

[13]"Ganitasarasangraha," Encyclopaedia Britannica, britannica.com/topic/Ganitasarasangraha.

something functioning like logarithms, and, again, in a rigorously graded concept of infinity, none of which appear in comparably developed form in the Greek tradition until much later, if at all.

Compared with the parallel Hindu astronomical-mathematical tradition of Aryabhata, Brahmagupta and Bhaskara — the tradition ganitanuyoga ran alongside for thirteen centuries — the difference is subtler and more interesting, because the two traditions were not hermetically sealed from one another; later Jain mathematicians such as Mahaviracharya explicitly knew and drew on Brahmagupta's work.[15] But the Hindu tradition's mathematics is embedded chiefly in astronomical treatises (siddhantas) written to compute planetary positions, calendars and eclipses — a fundamentally observational and predictive enterprise. Jain mathematics, even at its most astronomically minded, remains oriented toward a fixed cosmological picture rather than toward observation and prediction of the visible sky; its "numbers to describe an unimaginably large universe" character persists even in its most technical, least overtly religious passages, including the purely mathematical work of Mahaviracharya discussed in Part Three.

Ganitanuyoga's Own Table of Contents: The Ten Topics of Sankhyana

The clearest evidence that this was a self-conscious, organized field of study — not an incidental byproduct of religious writing — is that the tradition itself left behind something close to a syllabus. The Sthananga Sutra, one of the oldest texts in the Svetambara canon and generally dated by historians to before roughly 300 BCE, lists ten topics that together constitute the discipline it calls Sankhyana, "the science of numbers."[16] Later historians of Indian mathematics have noted that this list effectively set the agenda for Indian mathematical writing for a very long time afterward, well beyond the Jain tradition specifically.[17]

The ten topics, in the order generally given, are: parikarma, the fundamental arithmetic operations (addition, subtraction, multiplication, division, squaring, cubing, and their corresponding roots); vyavahara, general subjects of practical treatment; rajju, geometry and measurement using a cord or rope as the basic instrument, roughly analogous to what a modern reader would call mensuration by linear measure; rashi, the mensuration of solid bodies and heaps; kalasavarna, operations with fractions; yavat-tavat, literally "as much as," the treatment of simple (linear) equations; varga,

[16]Pearce, "Jaina Mathematics": the Sthananga Sutra, dated by most historians to before 300 BCE, is described as listing the topics that "set the scene for the areas of study for a long time to come in the Indian subcontinent."

quadratic equations; ghana, cubic equations; varga-varga, biquadratic (fourth-degree) equations; and vikalpa, permutations and combinations.[18]

Two features of this list deserve comment. The first is its sheer ambition for a text this early: a formal curriculum that runs from basic arithmetic through quadratic, cubic and even quartic equations, and closes with permutations and combinations as a named, independent topic of study — not an occasional technique buried inside a word problem, but a recognized branch of the discipline in its own right — is a genuinely advanced piece of intellectual organization for a text conventionally dated to the last centuries BCE. The second is what the list is not: it contains no entry for anything resembling formal proof, logical demonstration, or axiomatic method, confirming the picture given above of a results-and-method tradition rather than a proof tradition. The chapters of Part Two of this book are, in a sense, an extended commentary on this ten-item list, worked topic by topic through the specific canonical passages that develop each one.

Looking Ahead

Chapter Three turns from what ganitanuyoga covers to the harder and more contested question of where its content actually comes from: which texts carry this material, how those texts have survived, how confidently they can be dated, and what the split between the Digambara and Svetambara branches of Jainism means for treating any of this as a single, settled canon.

[18]The ten topics -- parikarma (fundamental operations), vyavahara (subjects of treatment), rajju (geometry/measurement by cord), rashi (mensuration of solids), kalasavarna (fractions), yavat-tavat (simple equations), varga (quadratic equations), ghana (cubic equations), varga-varga (biquadratic equations) and vikalpa (permutations and combinations) -- are listed with minor variants across secondary sources; see Pearce, "Jaina Mathematics," and the summary in Jainology Archives, "Ancient Jain Mathematics."

Chapter Three — The Canonical Sources: Dating and Provenance

A Literature Older Than Its Manuscripts

Every history of early Indian mathematics runs into the same structural problem, and Jain mathematics is no exception: the texts under discussion are very old, but the physical manuscripts that preserve them are, almost without exception, very much younger. Before a stable written canon existed, this material was transmitted orally within monastic lineages for generations, which means that any date given for a Jain canonical text is really a date (or, more honestly, a best scholarly estimate) for when its core content took the shape it now has, not a date for any surviving physical copy. This chapter works through the major sources one at a time, being as precise as the secondary literature allows about what is well established, what is a reasonable working consensus, and what remains genuinely disputed.

Surya Prajnapti and Jambudvipa Prajnapti

The two earliest texts of clear mathematical significance are the Surya Prajnapti ("Exposition on the Sun"), an astronomical text concerned with the movements of the sun and moon and the resulting structure of the calendar, and the closely related Jambudvipa Prajnapti, concerned with the geography and measurements of the central continent of Jain cosmology. Both are conventionally dated by historians to around the fourth century BCE, making them, if that dating is accepted, close contemporaries of the earliest Greek mathematical astronomy and considerably older than any of the classical Hindu astronomical siddhantas.[19] Both texts give explicit numerical values for astronomical periods and for the dimensions of cosmological structures, including, in the case of the Jambudvipa Prajnapti, some of the earliest attested values anywhere in Indian literature for the ratio of a circle's circumference to its diameter.

The fourth-century-BCE date, it should be said plainly, is a traditional and comparative dating rather than one anchored to an external, independently datable event of the kind that lets historians pin Mahaviracharya to 850 CE with confidence. Readers should treat it as the consensus estimate of the scholars this book draws on, not as an archaeologically settled fact.

Sthananga Sutra and Bhagavati Sutra

The Sthananga Sutra, discussed in Chapter Two for its list of the ten topics of Sankhyana, is generally placed somewhat later than the two Prajnapti texts, with most estimates converging on a date before roughly 300 BCE.[20] Its companion, and in some ways its more mathematically interesting neighbor, is the Bhagavati Sutra (also called the Viyahapannatti, "Exposition of Explanations"), a vast dialogue text conventionally dated to around 300 BCE, structured as a series of questions put to Mahavira, the twenty-fourth Tirthankara, by his chief disciple Gautama.

The Bhagavati Sutra is where the tradition's interest in combinatorics is most fully on display in the canonical period. The text works through problems of the following general shape: given a certain number of philosophical categories, or types of substance, or possible relations, in how many distinct ways can subsets of one, two or three of them be selected and combined? The text gives explicit rules for these counts — in effect, working formulas for what a modern reader would recognize as combinations of n items taken one, two, and three at a time — embedded not as abstract mathematics but as a technique for exhaustively cataloguing possible philosophical positions and states of knowledge.[21] This is combinatorics developed and applied roughly contemporaneously with, or somewhat earlier than, its first clear appearances anywhere else in the ancient world, and it is worth noting how easy it would be to miss entirely if one were reading the Bhagavati Sutra only as a work of religious dialogue and not also as a mathematical source — which is precisely what happened to it, in the general history of mathematics, for a very long time.

Uttaradhyayana Sutra and Anuyoga Dvara Sutra

The Uttaradhyayana Sutra, a text of mixed content combining ethical instruction with cosmological and mathematical material, is generally dated somewhat later than the Sthananga and Bhagavati, though still within the canonical period; it contains, among other things, an explicit statement that the circumference of a circle is a little more than three times its diameter — a working value for pi in the same broad family as the values given in the Surya Prajnapti and Jambudvipa Prajnapti, arrived at independently within the tradition's own cosmological-mensuration project.[22]

Later still — the secondary literature generally places it around the turn of the millennium, roughly the first century BCE to the first century CE — is the Anuyoga Dvara Sutra, which contains some of the tradition's most striking numerical material: an explicit three-way classification of all quantities into numerable (sankhyata), innumerable (asankhyata) and infinite (ananta), together with worked examples pushing very large enumerable quantities to their limit, including a repeatedly cited figure for the total number of human beings ever to have existed, expressed as a power of two in the neighborhood of two to the ninety-sixth.[23] This text is also credited by historians with laws governing successive powers and roots that amount, in substance, to the laws of exponents familiar from modern algebra — a^m times a^n equals a^(m+n), and (a^m)^n equals a^(mn) — developed as tools for exactly the kind of extreme-magnitude cosmological arithmetic the tradition kept needing.

The Digambara–Svetambara Question

No account of Jain textual history can avoid the central complication of the tradition's canon: Jainism split, in the early centuries of the common era, into two major branches, Svetambara and Digambara, and the two branches do not agree on what counts as authentic scripture. The Svetambara tradition holds that its canon was substantially fixed by a monastic council held at

Valabhi, in present-day Gujarat, conventionally dated to the fifth century CE, after a long period of oral transmission and partial loss.[24] The Digambara tradition, by contrast, holds that the original canonical texts (the Purvas and Angas in their complete, oldest form) were entirely lost over the centuries of oral transmission, and that what survives as Digambara scripture consists instead of later works composed by named authors — which is precisely why major Digambara mathematical-cosmological texts, such as the Dhavala commentary of Virasena discussed in Part Three, are treated as authored commentarial literature with a known writer and a known approximate date, rather than as anonymous revealed scripture.

This split matters for a book like this one in a very concrete way: several of the texts most central to the story told in Part Three — Virasena's Dhavala, Nemicandra's Trilokasara — belong to the Digambara commentarial tradition and are consequently far more securely datable than the Svetambara canonical texts discussed above, precisely because they are attributed works by named authors operating within a known royal court context, rather than redacted scripture of disputed and debated antiquity. Part Three treats that difference in evidentiary footing explicitly rather than presenting every Jain mathematical source as equally certain in its dating.

How the Texts Survived: The Manuscript Libraries

A final piece of the provenance picture concerns not composition but preservation, and it is a genuinely important part of the story rather than a footnote to it. A disproportionate share of everything historians know about early and medieval Indian mathematics, astronomy and literature more broadly survives because of manuscript libraries, or bhandaras, maintained by Jain monastic and lay communities at centres such as Patan, Jaisalmer, Cambay and Mudbidri.[25] The standard manuscript witness for Mahaviracharya's Ganita-sara-sangraha, the central text of Part Three of this book, includes a transcription preserved at a Jain monastery in Mudbidri, Karnataka, and the modern critical edition of that text, with English translation, published by the Government of Madras in 1912, drew directly on manuscripts gathered from exactly this kind of Jain institutional preservation.[26] The tradition, in other words, did not only produce this mathematics; a religious

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[24]The Jain canon in its Svetambara form is traditionally held to have been fixed at a council held at Valabhi in Gujarat, conventionally dated to the fifth century CE, after centuries of oral transmission; the Digambara tradition disputes the authenticity of this redacted canon altogether, holding that the original scriptures were lost. This split has direct consequences for which mathematical passages are considered canonical versus commentarial.

[25]On the role of Jain manuscript libraries (bhandaras) at centres such as Patan, Jaisalmer, Cambay and Mudbidri in preserving pre-modern Indian scientific and literary manuscripts, see the general codicological literature on Jain bhandaras; these repositories are widely credited by historians of the book in India with an outsized role in manuscript survival relative to the size of the Jain community.

[26]The Ganita-sara-sangraha manuscript tradition includes a transcription held at a Jain monastery in Mudbidri, Karnataka; the standard printed edition, with English translation and notes by M.

community organized specifically around textual preservation is a significant part of why any of it is still readable today — a point worth remembering when Part Four turns to the question of why that same material has had so little presence in the popular history built on top of it.

Method Going Forward

With the sources and their dating problems laid out, the rest of this book proceeds as follows: dates before Mahaviracharya (Chapter Fourteen) are given as scholarly consensus ranges, flagged as such on first mention in each new chapter; dates from Mahaviracharya onward are treated as comparatively firm, since they can be cross-checked against named royal patrons and, in several cases, epigraphic evidence. Part Two now turns to the mathematics itself, beginning with the theory of number and the concept that gives this tradition its most startling modern resonance: a rigorously graded theory of infinity, developed for reasons that had nothing to do with mathematics as a modern reader would define it, and everything to do with describing a universe precisely enough to argue about the fate of a soul within it.

Rangacharya, was published by the Government of Madras in 1912. See "Ganitasara Sangraha of Mahavira -- Book Summary," JainGPT, jaingpt.org.

Bibliography (Sources Cited in Part One)

Agrawal, D. P. "Ancient Jaina Mathematics: An Introduction." Infinity Foundation. infinityfoundation.com.

Datta, B., and A. N. Singh. History of Hindu Mathematics: A Source Book. Delhi: Bharatiya Kala Prakashan, 2004 reprint (orig. 1935–38).

Encyclopedia of Jainism. "Contribution of Ancient Jaina Scholars to Modern Mathematics." encyclopediaofjainism.com.

"Emergence of Mathematics in Ancient India: A Reassessment." arXiv:2403.04823 (2024).

"Ganitasarasangraha." Encyclopaedia Britannica. britannica.com.

"Ganitasara Sangraha of Mahavira — Book Summary." JainGPT. jaingpt.org.

Jain, L. C. Exact Sciences from Jaina Sources. Vol. 1: Basic Mathematics. Jaipur / New Delhi: Rajasthan Prakrit Bharati Sansthan / Sitaram Bhartia Institute of Scientific Research, 1982.

Jain, L. C. Exact Sciences from Jaina Sources. Vol. 2: Astronomy and Cosmology. Jaipur / New Delhi: Rajasthan Prakrit Bharati Sansthan / Sitaram Bhartia Institute of Scientific Research, 1983.

O'Connor, J J, and E F Robertson. "Mahavira." MacTutor History of Mathematics Archive, University of St Andrews. mathshistory.st-andrews.ac.uk.

Pearce, Ian G. "Jaina Mathematics." In Indian Mathematics: Redressing the Balance. MacTutor History of Mathematics Archive, University of St Andrews, 2002. mathshistory.st-andrews.ac.uk.

Note: this list will be consolidated into a single master bibliography at the end of Part Four, covering all sources cited across the complete book.